Exercises in botany.[5]

THIS little book, the author states, is designed to supply the need of pupils under the supervision of a teacher who can devote but little time to the subject, and is planned so that the teacher, burdened with other duties, need have little to do in the way of preparing outlines of the daily work. It contains many suggestive facts and various interesting observations not found in similar books. The colloquial and figurative style, which the author adopts to a considerable extent, doubtless aids in holding attention, but seems, at least here and there, to be carried beyond permissible limits in a work devoted to scientific teaching, as, for instance, when it is stated that the embryo of the western peony "does not intend to carry its store of food above ground, ... nor does it risk decapitation at the hands of Jack Frost." In some cases there is more or less obscurity, as in the question, "Which edge of an elm leaf is nearest the twig on which it grows?" And we are reminded of Grant Allen's "high priori" reasoning by the passage, "In short, an apple is good that its seeds may be distributed. A cherry is red that some cherry-loving animal may surely find it and drop its seed far from the parent tree."

On the whole, it may be doubted whether the book is likely to quite fulfill the author's purpose, and a careful examination strengthens the conviction that, however such books may be multiplied, the need of specially trained teachers is thereby increased rather than diminished. In the teacher's library, with others of its kind that are appearing at frequent intervals, it will serve a good purpose in suggesting observations and experiments.—V. M. S.

NOTES FOR STUDENTS.

PROFESSOR D. H. CAMPBELL,[6] has recently investigated the morphology of Naias and Zannichellia. He has confirmed the views of previous observers as to the axial nature of the stamens and ovules, and the mutual relation of leaf, axis, and branch. The stamen of *N. flexilis* is interesting on account of its being surrounded by two envelopes, the inner of which Professor Campbell regards as the homologue of the ovular integument which it greatly resembles, and the outer as corresponding to the carpel of the "female flower." The origin and development of the sexual elements, the growth of the pollen tube, and fertilization do not depart materially from the usual angiospermous type.

The first division of the embryo is transverse, as usual, dividing it into a basal or "suspensor" cell and a terminal or "embryo" cell. The further development of the embryo agrees with Schaffner's account of Alisma as

[5] RATTAN, VOLNEY.—Exercises in Botany for the Pacific States. The Whitaker & Ray Co., San Francisco. 1897.

[6] Proc. Cal. Acad. Sci. 3d series 1 : 1–62. *pl. 5.* 1897.

opposed to Hanstein's. The suspensor cell enlarges considerably, but remains undivided, and all the embryo and the secondary suspensor cells are derived from the embryo cell which first becomes divided transversely into a number of segments. In *N. flexilis* the terminal segment of the row thus formed gives rise to the cotyledon, the second to the stem, and the third and fourth to the root. In Zannichellia the terminal segment divides vertically, one-half becoming converted into the cotyledon, and the other into the stem, the second, third and fourth segments give rise to the root, and the fifth to the root-cap. The embryo of *N. flexilis* is peculiar in having no trace whatever of a root-cap; that of Zannichellia in the terminal origin of the stem.

The endosperm in both genera is rudimentary. In the later stages of the embryo-sac of *N. flexilis* there is always present near the antipodal cells a large nucleus which increases to an enormous size but does not undergo division. Since Professor Campbell did not succeed in demonstrating a fusion of the polar nuclei, he is inclined to doubt whether such a fusion takes place, and to regard this large persistent nucleus as one of the unfused polar nuclei. As an alternative explanation he suggests the possibility that this large nucleus may be one of the two originating from the first division of the definitive nucleus. The correctness of the latter explanation would seem to be indicated by the presence in Zannichellia of a similar large nucleus, although fusion of the polar nuclei probably occurs, as well as by Schaffner's observation[7] that in *Sagittaria variabilis* there are only two or three derivatives of the lower endosperm nucleus and these enlarge enormously.—W. R. S.

ITEMS OF INTEREST on the subject of insect pollination are given by E. Ule.[8] Observations, made chiefly in Brazil, indicate that *Asclepias Curassavica* is usually pollinated by *Danais Euripus*, "a large red-brown spotted butterfly," whose wings resemble in color the flower of the Asclepias. It is said that this butterfly rarely visits other flowers, though large numbers of nectar-bearing flowers are often found in the same locality. Other butterflies frequently seen in this locality very rarely visit this particular species; but when visiting it were seen to load themselves with pollen just as the *Danais Euripus*, and probably bring about pollination with equal effectiveness though in a smaller number of cases. It is also said that this butterfly has been a constant companion in the migrations of this milkweed as it has spread from America. The caterpillars of the butterfly live and feed upon the plant, but seldom cause any injury to it.

The author cites the above as a case of symbiosis, under the category of mutualism. The Asclepias is pollinated and pays for the favor by giving

[7] BOT. GAZ. **23**: 267. 1897.

[8] Ber. der deutsch. bot. Gesellschaft **15**: 385–387. 1897.

resting place and food both to the butterfly and its offspring, the caterpillar. Just how far the term symbiosis is to be extended is becoming quite a question. If the above happy case of reciprocity is a true case of symbiosis, we must extend the application of the term to the conditions existing between certain groups of animals and plants. And if we extend it to this we shall be well on the way toward saying that the relations between plants and animals at large give us a gigantic illustration of symbiosis. There are many who are disposed to limit the term symbiosis to those more intimate relationships of organisms, cases of actually living together, the "commensaux" condition. As to how far the term shall be extended to those cases where organisms are dependent upon each other for a brief period, mutually or otherwise, becomes a question of degree rather than content.—O. W. C.

AN IMPORTANT contribution to the bacteriology of plant diseases has been made by Dr. Erwin F. Smith [9] in a study of brown rot in various cruciferous plants, especially in turnips, cabbage, and kale. A yellow, motile germ, of micrococcus-like appearance, has been isolated and its behavior in the laboratory under various conditions tested. It is aerobic, produces no gas or acid, and forms no spores.

In the cruciferous host it is chiefly found along the fibro-vascular bundles, especially in the vessels, and brings about a characteristic brown discoloration not shown when grown upon other media. A very interesting observation was made in reference to its dispersion within the host. It travels along the vascular strands with readiness, but passes from one to another through the intervening parenchymatous layers with difficulty. The inhibitory condition appears to be due, in part at least, to the acidity of the parenchymatous sap, the organism preferring the alkaline fluids of the bundles.

Many interesting, novel and important details of the study cannot be even alluded to in this connection. The work has established beyond any seeming possibility of cavil another marked disease of plants caused by parasitic bacteria.

The natural infection appears to be through the leaves, partly by the gnawing of worms and insects, and partly by the entrance of the germs through the water pores when root pressure fills them with sap. The disease is apparently widespread, and of considerable economic importance. It does not break down the tissues to any marked extent, but beside producing a discoloration it checks the growth, and often causes the leaves to yellow and drop, making the crop a failure. There is a curious omission of reference to the researches of Dr. H. L. Russell on this disease, some of which have already been published, as well as to those unpublished of which Dr. Smith

[9] SMITH, ERWIN F.—*Pseudomonas campestris* (Pammel), the cause of a brown rot in cruciferous plants. Centr. f. Bakt. Par. u. Infekt. 3:284–291, 408–486, *col. pl. 6*. 1897.

was fully cognizant. We reserve further comment upon this matter until the publication of Dr. Russell's paper, of which advance sheets have reached us. —J. C. A.

THE *Journal of Botany*[10] has reprinted from the 15th Ann. Rep. of the Fishery Board of Scotland some observations by Mr. George Murray on the plankton of the west coast of Scotland. Mr. Murray finds the bulk of this free-floating vegetation to consist of about ten species of diatoms and a few Peridineæ. In the early months of the year diatom life prevails, reaching its maximum aboat the first of April; in the latter part of the year Peridineæ forms predominate, culminating in August. During the entire year the most favorable zone for diatom development was at a depth of five fathoms, with the prominent exception of *Skeletonema costatum*, which was practically confined to the surface in March and April. Mr. Murray's observations go to prove that small crustacea live almost entirely upon diatoms. Such species as have spines, and the Peridineæ forms, do not serve apparently as daily food for the lower forms of animal life. Besides the ordinary division and the formation of auxospores, reproduction of diatoms by means of endogenously formed spores or endocysts was observed. In some cases as many as sixteen of these reproductive bodies were produced in one diatom, and in summer they were found with unsilicified membranes, dissociated from the parent and undergoing further division. Later in the season forms like the parent reappeared.—H. W. L.

L. A. GAYET[11] has recently completed a monograph on the development of the archegonium in the bryophytes. The article occupies about one hundred pages and sets forth the results of six years' work. A few of the most important points are as follows. The terminal cell, often called the cover cell, contributes to the growth of the neck of the archegonium in the Hepaticæ as well as in the Musci, although the terminal cell is much more active in the latter. The terminal cell does not give rise to neck canal cells either in the Hepaticæ or Musci, but all the neck canal cells are of the same origin, and come from an initial detached from the mother cell of the oosphere. There are also observations on the pedicel cell, the number of neck canal cells, and the number of longitudinal rows in the neck. There are occasionally two ventral canal cells in Sphærocarpus. In one case the ventral canal cell of Marchantia was fertilized instead of the oosphere.

The development of the archegonium of the Anthoceroteæ is so different from that of other bryophytes that the author makes the Anthoceroteæ a group coordinate with Hepaticæ and Musci, and places it, not in its usual

[10] Jour. Bot. 35:387–395. 1897.

[11] Recherchés sur le developpement de l'archegone chez les Muscinees. Ann. Sci. Bot. VIII. 3: 161–258. 1897.

position just preceding Musci, but between the Musci and pteridophytes. He believes that the group is more nearly allied to the pteridophytes than to the Hepaticæ.

An artificial key to the Hepaticæ, Musci, and Anthoceroteæ is given, based entirely upon archegonium characters. This recalls Treub's effort to base a classification upon chalazogamy.

No mention is made of Campbell's recent book upon mosses and ferns, although quite an extensive bibliography is given. A perusal of this book would probably have added to the value of M. Gayet's monograph.—C. J. C.

WIESNER has made another valuable addition to his various studies on the influence of rain on the plant world. Readers of the GAZETTE will remember in this connection his studies on ombrophilous and ombrophobous organs.[12] His latest work has been to observe the mechanical influence of rain on plants.[13] After referring to the researches of Jungner and Stahl on the adaptations of tropical leaves to rain, the author refers to the common view among botanists that rain works mechanical injuries on plants, although this view is based wholly on theory rather than on actual experimentation.

Wiesner found that the heaviest rain drops, whether in or out of the tropics, weigh but 0.16^{gr}, and that the greatest velocity attained is but 7^{m} per second. Hence the "greatest living force" possible is but 0.0004^{kgm}. Rarely more than six heavy drops fall per second on a space of $100^{sq\,c}$. Water poured from a watering can so slowly as to strike the ground in drops has from fifty to one hundred times this force. The author then records experiments on leaves and flowers and finds, for example, that the corolla of *Impatiens noli-tangere*, when placed on a firm support, is injured by a sphere of lead weighing one gram falling 4^{cm} ($=0.000004^{kgm}$); while swinging free in nature it requires a force of 0.08^{kgm} to produce an injury, *i. e.*, a force 20,000 times as great, and a force 200 times as great as that exerted by the severest rain! Similar results are obtained from all experiments, so that the author concludes that leaves and flowers are practically never mechanically injured by rain alone where swinging free in nature. This conclusion might be reached *a priori* from the fact that tropical leaves, which are exposed to more rain than plants of our latitude, are nevertheless less adapted to stand mechanical injury; for example, they absorb water more freely, thus becoming less protected from mechanical impact, and even when dry they are more readily perforated than our ordinary leaves.

While rain produces little or no mechanical injury when unaccompanied by wind, the destruction due to wind and rain combined is quite patent, but although the water may here do actual mechanical harm, the wind rather

[12] BOT. GAZ. **20**: 112. 1895.

[13] Untersuchungen über die mechanische Wirkung des Regens auf die Pflanze. Ann. Jard. Bot. Buit. **14**: 277–353. 1897.

than the rain is to be regarded as the real cause. The rain of itself produces injury, not mechanical but of a secondary nature; the fall of leaves several hours after a rain may be regarded as due to the fact that the organic separation of the leaf from the tree is hastened by the increased turgescence caused by the rain.--H. C. C.

A RECENT PAPER by Kny[14] confirms the earlier work of Boussingault and Jodin, in affirming a close dependence of the chlorophyll function upon the living plastid and the cytoplasm. The author used as test fluids various blue solutions which had been decolorized with sodium hydrosulfite. Any free oxygen which might be present was driven off by heating, and the liquid again decolorized. This precaution had apparently been neglected by Regnard, who had employed similar methods. Engelmann's bacteria test was also used, this being a very delicate indicator of the presence of oxygen.

In studying chlorophyll separated from its living matrix, its solution in olive oil, or dried into absorbent paper, was used, also portions of plants killed by scalding or drying. All the tests agreed in finding no oxygen liberated during isolation. The results of experiments upon living chloroplastids removed from cytoplasm do not agree with those obtained by Engelmann, Haberlandt, and Pfeffer. Plastids from plants liberated oxygen in no case except where cytoplasm was adhering to them.

Certain external influences were next applied in order to note their comparative effects upon the cytoplasm and chlorophyll function. Plasmolysis did not stop the activity of chlorophyll as long as the protoplasm showed no plain sign of dying. Electricity, moderately applied, had a stimulating effect. Tapping upon the object under the cover glass gave varying results. The ability of plastids to resume activity after having been dried depended on the life habits of the plant, lichens and mosses showing a marked contrast to spirogyra, for example. A temperature of about 50 checked the work of photosyntax before the cytoplasm and chromatophore were perceptibly altered. By shortening the time of exposure sufficiently, these last results were practically reversed. Chloroform affected cytoplasm and chromatophore before the chlorophyll function was checked. The same thing was observed when weak solutions of ammonia and of nitric acid were applied. The general conclusion from these experiments is that the injury to the chlorophyll function does not proceed parallel to that of the cytoplasm and nucleus.—W. D. M.

[14] Die Abhängigkeit der Chlorophylfunction von dem Chromatophoren und vom Cytoplasma. Ber. d. deutsch. bot. Gesells. 15: 388–403. 1897.